

**State of California
California Department of Fish and Wildlife
North Central Region**

Indian Creek Reservoir, Alpine County

**Summary Report of Roving Creel Surveys (2009, 2011-2013) and Angler Survey
Box Analysis (2015 – 2019) at Indian Creek Reservoir**



Photo courtesy of M. Mamola

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Introduction

Indian Creek Reservoir (ICR) is approximately three miles north of Markleeville, off Highway 89, in eastern Alpine County (**Figure 1**). ICR is within the East Fork Carson River watershed and was originally constructed by South Tahoe Public Utility District between 1968 and 1970 to store tertiary treated wastewater exported from the Lake Tahoe basin. In 1989, the input of this treated wastewater ceased, but ICR is still a recreational sport-fishing destination due to continued stocking efforts from California Department of Fish and Wildlife (CDFW) and the Alpine County Fish and Game Commission (Alpine County). ICR has a maximum estimated depth of 50 feet and sits at an elevation of 5600 feet above mean sea level. In average water years, ICR has a surface area of 110 surface acres. ICR has no large, natural tributaries, receiving most of its inflow from a diversion from the West Fork Carson River. ICR supports various fish species, including: non-native Rainbow Trout (*Oncorhynchus mykiss*, RT) and Brown Trout (*Salmo trutta*, BN), as well as Lahontan Cutthroat Trout (*Oncorhynchus clarkii henshawi*, LCT), which are the only trout native to the eastern Sierra Nevada. Other native fish found in ICR include the Tui Chub (*Gila bicolor*, TC), Mountain Whitefish (*Prosopium williamsoni*, MWF), Mountain Sucker (*Catostomus platyrhynchus*), Lahontan Redside (*Richardsonius egregius*), and the Tahoe Sucker (*Catostomus tahoensis*). Largemouth Bass (*Micropterus salmoides*, LMB) also occur in ICR. CDFW stocked Brook Trout (*Salvelinus fontinalis*, BK) at ICR in 2002, but have not been reported in the last nine survey years.

Both CDFW and Alpine County currently stock ICR. Both entities stock RT, only CDFW stocks LCT. Stocked sizes include fingerling, sub-catchable, catchable, and super-catchable (trophy) fish. Fingerling and sub-catchable trout are stocked under a put and grow management strategy, while catchable and trophy trout are stocked under a put and take management strategy. CDFW is implementing a put and grow strategy with the fingerling and sub-catchable LCT. Rapid growth is expected from the fingerling and sub-catchable size trout due to the high productivity of ICR.

Methods

Anglers were asked to complete a voluntary survey form about their fishing experience at one of the two angler survey boxes (ASB) at ICR. The survey asked anglers for information regarding hours fished, type of gear used, angling method, and the number of landed fish. Anglers were also asked the size and species of the fish landed and whether they kept or released their catch. Finally, the survey asked three questions about angler's satisfaction of overall angling experience, size, and number of

fish. Anglers recorded their answers on a scale of -2 to +2, with “+2” representing most satisfied and “-2” representing least satisfied. The back of the survey form was reserved for anglers who had additional comments. The 2009, 2011–2013 data used for comparison in this report were gathered using the roving creel survey in which a CDFW scientific aide interviewed anglers about their angling experience (Hood 2013).

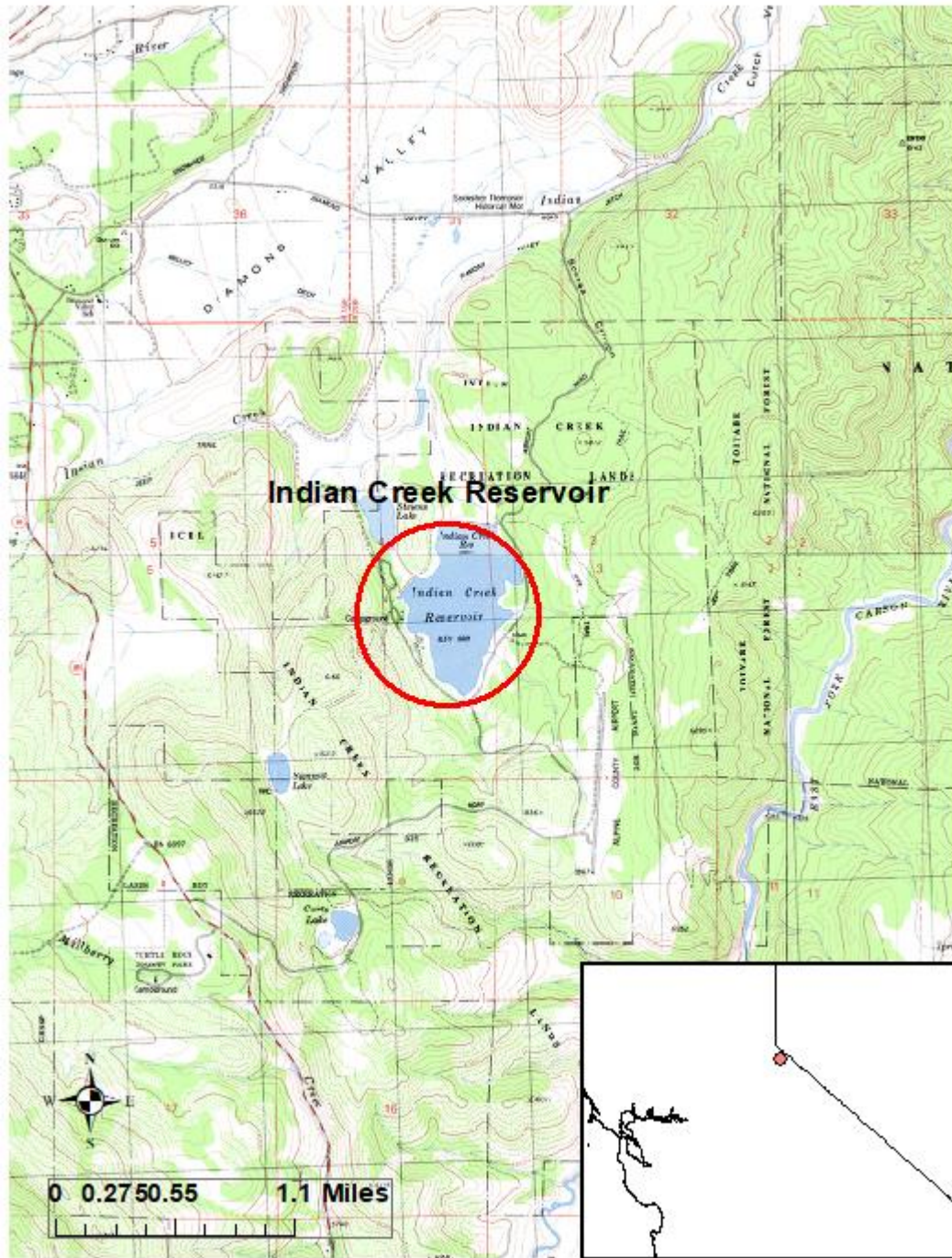


Figure 1. Indian Creek Reservoir, Alpine County. Indian Creek Reservoir is also indicated by a beige dot in the inset map in relation to California.

Results

Forty-five anglers responded to the ASB survey in 2019. The nine-year average, including anglers who responded to the 2009 and 2011–2013 roving creel surveys was 74 (Hood 2013) (**Table 1**). Cumulatively, these anglers landed an average of 182 fish annually and averaged 239.1 hours of fishing (0.74 catch/hour). The 2020 catch per angler average and catch per hour were the highest on record.

Table 1. Collection of average effort and catch statistics recorded from the roving creel surveys in 2009 and 2011–2013 and the 2015–2019 angler survey box (ASB) at Indian Creek Reservoir.

Year	Respondents	Hours Fished	Fish Landed	Catch per Hour	Catch per Angler
2009	143	361.5	242	0.67	1.69
2011	45	134.0	11	0.08	0.24
2012	10	32.5	14	0.43	1.40
2013	98	248.0	103	0.42	1.05
2015	81	318.5	387	1.22	4.78
2016	115	436.5	270	0.62	2.35
2017	71	269.5	191	0.71	2.69
2018	56	207.3	175	0.84	3.13
2019	45	144.5	243	1.68	5.40
Average	74	239.1	182	0.74	2.53

Like 2017, bait anglers (n = 22) caught the greatest number of fish (64.2%) in 2019 (**Table 2**). Prior to 2017, fly anglers caught the greatest number of fish (49.9% in 2015; 52.2% in 2016). Lure anglers (n = 4) caught the lowest percentage of fish in 2019 (4.1%). This is the second time since 2015 that lure anglers caught the least number of fish.

Table 2. The number of fish landed by the type of gear from 2015–2019.

Year	2015	2016	2017	2018	2019
Angling Method					
Bait	153 (39.5%)	96 (35.6%)	94 (49.2%)	67 (38.3%)	156 (64.2%)
Lure	5 (1.3%)	8 (3.0%)	14 (7.3%)	25 (14.3%)	10 (4.1%)
Fly	193 (49.9%)	141 (52.2%)	64 (33.5%)	77 (44.0%)	29 (11.9%)
Multiple	15 (3.9%)	6 (2.2%)	7 (3.7%)	6 (3.4%)	34 (14.0%)
Not recorded	21 (5.4%)	19 (7.0%)	12 (6.3%)	NA	14 (5.8%)
Total	387	270	191	175	243

Anglers caught more fish in 2019 (n = 243) than 2018 (n = 175) and 2017 (n=191) (**Table 3**). In 2019, 72.4% of fish landed were RT, 14.0% were unknown fish, 6.6% were TC, 5.8% for LCT, and less than 1% were for LMB and MWF each, respectively. The catch rates correspond with CDFW and Alpine County stocking records for 2019, during which 6,800 lbs. of RT and 627 lbs. of LCT were stocked compared to the amount stocked in 2017 (4, 900 lbs. RT) and 2018 (4,200 lbs. RT) (**Table 4**).

In 2019, RT were caught in the greatest numbers for the fourth consecutive year. Of the 176 RT caught, 47.7% were released. The percentage of RT released is lower than the prior three years (70.6%, 2018; 50.8%, 2017; and 64.7%, 2016). In 2019, anglers released 58.8%, of all species caught, compared to 70.9% in 2018, 50.8% in 2017, and 64.7% in 2016.

Table 3. Kept and released fish at Indian Creek Reservoir in 2009, 2011–2013, and 2015–2019.

Year	Species	Kept	Released	Unknown whether Kept or Released	Total Caught	Percent of Total Catch	Percent Released
2009, 2011 - 2013	BN	7	10	NA	17	4.6%	58.8%
	LCT	8	14	NA	22	5.9%	63.6%
	RT	136	193	NA	329	88.9%	58.7%
	Unknown	0	2	NA	2	0.5%	100.0%
TOTAL 2009, 2011 - 13		151	219		370		
2015	BN	6	2	NA	8	2.1%	25.0%
	LCT	52	160	NA	212	54.8%	75.5%
	RT	95	71	NA	166	42.9%	42.8%
	Unknown*	0	1	NA	1	0.3%	100.0%
TOTAL 2015		153	234		387		
2016	BN	2	0	NA	2	0.7%	0.0%
	LCT	4	45	NA	49	18.1%	91.8%
	RT	76	141	1	218	80.7%	64.7%
	Unknown	0	1	NA	1	0.4%	100.0%
TOTAL 2016		82	187	1	270		
2017	BN	2	4	NA	6	3.1%	66.7%
	LCT	2	3	NA	5	2.6%	60.0%
	RT	88	91	NA	179	93.7%	50.8%
	LMB	0	1	NA	1	< 1.0%	100.0%
TOTAL 2017		92	99	0	191		
2018	BN	1	15	NA	16	9.1%	93.8%
	LCT	5	24	NA	29	16.6%	82.8%
	RT	35	84	NA	119	68.0%	70.6%
	SKR	0	0	10	10	5.7%	NA
	Unknown	0	1	NA	1	0.6%	100.0%
TOTAL 2018		41	124	10	175		
2019	MWF	0	2	NA	2	0.1%	100.0%
	LCT	4	10	NA	14	5.8%	71.4%
	RT	92	84	NA	176	72.4%	47.7%
	LMB	0	1	NA	1	0.0%	100.0%
	TC	3	13	NA	16	6.6%	81.3%
	Unknown	1	33	NA	34	14.0%	97.1%
TOTAL 2019		100	143	0	243		

* Unknown trout species

Table 4. CDFW and Alpine County stocking events at Indian Creek Reservoir from 2009 - 2019.

CDFW						Alpine County	
RT			LCT			RT	
Year	lbs.	Number	Year	lbs.	Number	Year	lbs.
2019	2000	3800	2019	400	200	2019	1800
	3000	6300		227	1498		
2018	600	1,020	2018	800	400	2018	3600
				150	1,110		
2017	300	900	2017	83.3	750	2017	3600
	900	2970		83.3	750		
	100	370		300	150		
				90	756		
				90	756		
				500	250		
2016	0	0	2016	320	4192	2016	3600
				605	242		
				145	58		
2015	580	1508	2015	174	87	2015	3600
	1000	1500		200	100	2014	3600
2014	1600	3040	2014	600	300	2013	3600
2013	1220	2806		71.1	1209	2012	2800
	610	2013		2200	6160	2011	4950
2012	317.5	6000	2013	300	150	2010	3800
	2000	6000		300	150	2010*	1000
	625	2000		1376	14998	2009	16800
2011	674	5999	2012	1149	9996	2009*	2200
	1000	2000		220	110		
	3000	5400		380	190		
2010	1000	1500	2011	300	150		
	970	6014		300	150		
2009	599.7	4618	2010	600	300		
			2009	300	200		
	22096.2	65758		12263.7	45362		54950

*Denotes brown trout plant

In 2019, four boat anglers (8.9%) had the highest catch per angler average (13.00) (**Table 5**). Twenty-seven shore/wading anglers (60.0%) had the second highest

catch per angler average (5.15 catch/angler). Six anglers (13.3%) who did not record their angling method had a 3.83 catch per angler average. Lastly, eight float tube anglers had a 3.63 catch per angler value.

Table 5. The number of anglers and catch per angler based on angling method at Indian Creek Reservoir from 2016 - 2019.

Method	Year							
	2016		2017		2018		2019	
	Number of Anglers	Catch per Angler	Number of Anglers	Catch per Angler	Number of Anglers	Catch per Angler	Number of Anglers	Catch per Angler
Boat	7	1.86	6	5.50	1	1.00	4	13.00
Float tube	10	5.30	28	2.32	23	3.35	8	3.63
Shore or Wading	4	0.75	30	2.30	27	3.07	27	5.15
Multiple	NA	NA	NA	NA	1	3.00	NA	NA
Not recorded	94	2.14	7	3.43	4	2.75	6	3.83

In 2019, the modal length class for RT was 10.0 – 11.9 inch (in.) (n = 93) and 12.0 – 13.9 in. in 2018 (n = 50). In 2019, the modal length class for LCT was 12.0 – 13.9 in. (n = 6). In 2018, the greatest number of LCT (n = 8) were both in the 12.0 – 13.9 in. and < 6 in. length classes, respectively (**Figure 2**). The modal length class for TC was 6.0 – 7.9 in. in 2019 (n = 13). Two MWF and one LMB collected in 2019 were < 6.0 in.

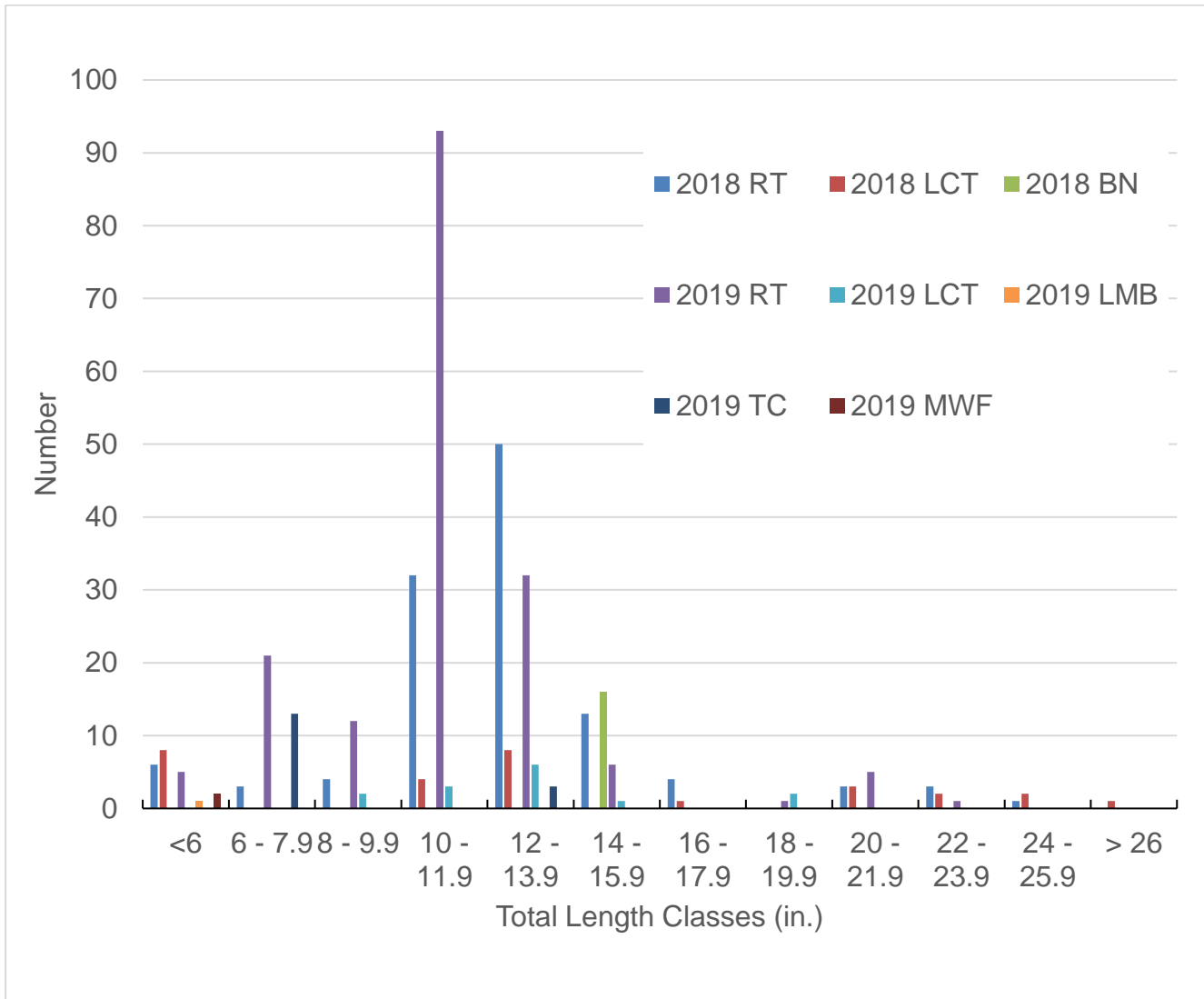


Figure 2. Frequency of identified fish in each length class that anglers reported landing at Indian Creek Reservoir in 2018 and 2019.

In 2019, anglers were satisfied with their overall angling experience for the third consecutive year (**Table 6**). Also, 2019 was the second highest average value on record (0.91). Anglers were satisfied with the size of fish over the entire nine-year sampling period, showing little variation across response years (**Table 6**). Anglers were satisfied with the number of fish caught in 2019 (1.25 average), which was also the highest value recorded.

Table 6. Angler satisfaction averages for the Indian Creek Reservoir fishery from 2009, 2011–2013, and 2015–2019.

Year	Overall angling experience	Size of the fish	Number of fish
2009, 2011 - 2013	1.43	1.03	1.01
2015	0.66	0.94	0.76
2016	-0.30	1.05	0.00
2017	0.77	1.00	0.38
2018	0.64	1.00	0.41
2019	0.91	0.88	1.25
Average	0.69	0.98	0.64

Discussion

Anglers caught over two fish per trip, on average for a fifth consecutive year, likely considered successful for many anglers. The 2019 CPUE (1.68) was the highest on record. The 2019 overall catch ($n = 243$) also increased from 2018 ($n = 175$) and 2017 ($n = 191$). The cyanobacteria issues that occurred at ICR in 2019 may have deterred many anglers from fishing, but those that did were overall very successful. The water quality was poor, had a green color, and was a hazard to humans, pets, and wildlife. During bloom events, signs were displayed around the lake advising the public of the health hazards that were present to humans and their pets. Cyanobacteria blooms caused by eutrophication lead to serious impacts on aquatic ecosystems and human health (Jin et al. 2015).

The greatest number of RT caught were in the 10.0–11.9 in. size class in 2019. This corresponds with anglers being satisfied with the size of their catch for a ninth consecutive sampling year, but may explain the lowest value in the nine years, as well. Anglers may have been satisfied with catching 10.0–11.9 in. fish, but would have liked to catch larger-sizes. Anglers were also satisfied with the number of fish caught in 2019. This is an increase from any prior year. The increase could have occurred because of the large amount of fish available compared to the amount of anglers fishing ICR.

Fewer LCT were caught in 2019 than 2018 (Ewing 2019a). LCT may be more susceptible than RT to poor water quality (e.g. cyanobacteria) at ICR. In recent years, CDFW has stocked brood-stock (≥ 2 lbs.) LCT from Heenan Lake (Alpine County) into ICR. However, prior to 2018, anglers did not report catching many of these larger fish.

For example, only one LCT over 20 in. was reported caught in 2017, none in 2016, and only three in 2015. In 2018, eight LCT over 20 in. were caught, but none in 2019. In 2018, some of the brood-stock may have still been in spring spawning mode. During early spring and early summer of 2018, LCT gathered in large numbers by the inlet to ICR, which allowed shore anglers easier access to the congregating LCT (**Figure 3**). These consistent inlet flows may have contributed to angler catch success compared to the lack of flows during earlier drought conditions. In 2019, high flows were not present at the inlet, thus providing less of an opportunity for shore anglers to catch these large LCT.



Figure 3. Mike Mamola with LCT caught near inlet at ICR in 2018. (Photo courtesy of M. Mamola)

Because LCT were stocked during their spawning season, a portion of brood-stock LCT may have also swam downstream into the afterbay. A study found that the movement behavior of BN varies with fish size and life stage (Jonsson 1985; Huusko et al. 1990), and hatchery-reared, lake-run BN may show movement behavior similar to that of wild fish (Huusko et al. 1990). LCT stocked in ICR during the spawning season may exhibit some of the same behaviors as BN.

In 2020, CDFW will continue to stock ICR with LCT brood-stock. If the inlet at ICR maintains adequate flow into the reservoir throughout spring 2020, as observed two and three years ago, more trophy-sized LCT may become available for anglers. During drought years, the inlet flows minimally, which may cause LCT to go into the afterbay, which is on private property and does not provide angler access.

It is often difficult to manage a fishery to satisfy both high catch rates and large fish size. This is because larger-sized fish demand a greater amount of food than smaller-size fish. With a certain amount of available food, either the fishery can hold many, smaller-sized fish or less, larger-sized fish. ICR has provided both large fish and high catch rates over the nine years of this study. The long growing season, large amounts of baitfish, and large allotments may be some of the reasons why ICR has been able to satisfy anglers in both numbers and sizes.

Anglers released most of the fish caught at ICR in 2019. Every year's ASB survey shows that LCT are being released at a higher percentage than RT. Overall, anglers continued to release a large percentage of fish species caught at ICR. In recent years, fishing clubs and many outdoor writers have promoted the idea of catch and release fishing. They argue that catching a fish is the most valuable component of the recreational fishing experience, and if fish are released unharmed, they might be available for recapture on a future fishing trip (Clark 1983). Mortal hook wounds in smaller fish may persuade some anglers to keep smaller-sized fish rather than releasing them. Anglers may also release smaller fish in hopes of catching a larger fish to harvest. Alpine County stocks RT from Desert Springs Fish Hatchery in which the RT's meat is a pink color and has been an angler favorite according to Alpine County (T. Sadaro, Pers. Comm.). It is also possible that anglers like the taste of RT more than LCT, which could explain why more RT are harvested.

ICR also has a LMB population (**Figure 4**) where anglers have caught LMB over five pounds, but only two have been reported in the last three years. Factors influencing the yield of stocked salmonids include predation (Larsson 1985; Blackwell and Juanes 1998; Dieperink et al. 2001). It is possible that LMB could be predated on RT and LCT, especially the fingerling-sizes, but the actual percentage is unknown.

For a third consecutive year, shore angling was the most frequent method of angling. This may be a result of increased access to quality shoreline after a record 2016/2017 winter and average to above-average 2017/2018 and 2018/2019 precipitation. ICR is a highly eutrophic reservoir that has large amounts of aquatic vegetation covering the water surface during the summer months. In 2016, vegetative cover may have impeded fishing success for shore anglers when compared to float tube anglers.



Figure 4. John Hanson with LMB caught at ICR.
(Photo courtesy of M. Mamola)

In 2019, the overall fishing experience for anglers at ICR was positive for the fourth time in five years. One explanation for the overall positive angling experience in 2019 could be that both the number of fish and size of the fish had positive average values. Anglers have only had a negative average angling experience response once in nine years of surveys. This suggests that the fishery has provided a satisfactory experience for a majority of the survey period.

Forty-five anglers responded to the 2019 survey, which is a fair number for an ASB (Ewing 2019b), but below the ICR average of 74. In 2019, ICR endured very poor water quality, which resulted in multiple poor water quality postings across the reservoir, discouraging water contact for both humans and pets. These conditions likely deterred anglers, many of whom probably decided to fish elsewhere.

Recommendations

- Keep ASBs at ICR for one more year.
- Continue same stocking efforts for RT and LCT.

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